BP BIOFUELS ITUIUTABA AND ITUMBIARA PRODUCTION FACILITIES

LIFECYCLE ANALYSIS REPORT

CALIFORNIA LOW CARBON FUEL STANDARD METHOD 2A PATHWAYS

APPLICANT:

BP BIOCOMBUSTÍVEIS S.A. (EPA ID: 4427)

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GENERAL INFORMATION:

BP BIOCOMBUSTÍVEIS S.A. (BP Biofuels) operates three sugarcane mills in Brazil. Two of them -- Itumbiara and Ituiutaba have similar design and operating conditions. The Central Itumbiara de Bioenergia e Alimentos facility is located in the State of Goias, and the Ituiutaba Bioenergia facility in the State of Minas Gerais. Both mills have advanced cogeneration capacity and supply electricity to Brazilian grid. This sub-pathway application is for the Itumbiara and Ituiutaba mills.

In 2010 BP Biofuels have implemented a number of technologies and measures that reduced steam use within the process and improved electricity efficiency of cogeneration. This application seeks a new pathway for the two BP Biofuels mills to reflect their low energy use and higher efficiency of electricity co-generation, and subsequently lower carbon intensity than the reference pathway. BP Biofuels pathway is a sub-pathway of the Brazilian sugarcane with average production process, mechanized harvesting and electricity co-product credit. The sugarcane cultivation, sugarcane transport and ethanol transport of BP Biofuels pathway are identical to those in the Brazilian-Sugarcane-to-Ethanol Pathway. The difference is that a significant proportion of ethanol is produced from molasses -- a by-product of the sugar production process. This application is for two different pathways for each mill – one for ethanol produced from sugar cane juice directly, another for ethanol produced from molasses.

The application contains confidential commercial/trade secret information. The confidential information in the application and supporting documentation has been clearly marked as such. Confidential information is not included in the public version of the application.

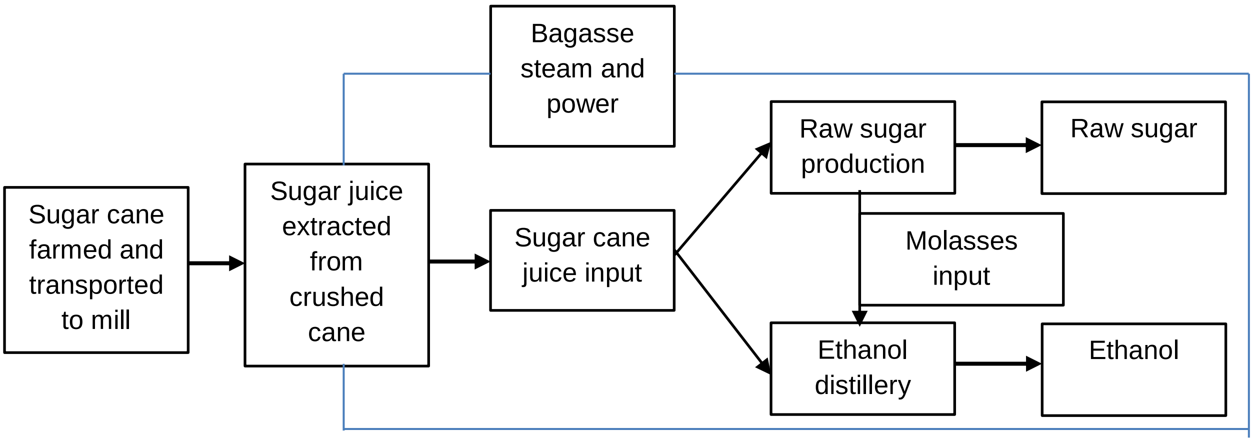
BP BIOFUELS PLANT AND PROCESS DESCRIPTION:

BP operates two sugar cane ethanol production facilities, Ituiutaba and Itumbiara mill, each having crushing capacity of 2.5 million metric tonnes of sugar cane. Overall BP Biofuels sugarcane operations are similar to those reviewed by CARB for the average sugarcane ethanol pathways with the exceptions described below. The pathway diagram is shown below in Figure 1.

Sugar juice, extracted from sugar cane crushing, is separated into two streams: one stream goes into sugar production, while the other into ethanol production. The sugar production process generates molasses as a by-product, which are transported by pipe as an additional feedstock into the ethanol distillery and fermenter.

Figure 1

Process Flow Diagram for the Production of Ethanol from Sugar Cane Juice and Molasses



The mills achieve an improved co-generation credit than the reference pathway through three principal means. Firstly, the mills have modern high thermal efficiency, high pressure and high temperature boilers. Secondly, the efficiency of the turbo-generator is significantly higher than assumed for the reference pathway. Thirdly, the plant has energy efficient equipment and implemented a number of energy saving measures.

ALLOCATION OF UPSTREAM EMISSIONS AND CO-GENERATION CREDIT BETWEEN SUGAR AND ETHANOL. CREDIT FOR MECHANIZED HARVESTING:

The upstream emissions related to farming, agricultural operations and sugarcane transport are allocated using the mass-based allocation methodology. The share of emissions allocated to ethanol produced from molasses is based on the ratio of the total reduced sugars (TRS) in the molasses entering the ethanol distillery to the total reduced sugars that enter the sugar production process for each ton of sugarcane that enters the factory gate. On the other hand, all upstream emissions are allocated to ethanol produced from sugarcane juice feedstock.

The electricity co-product input used in CA-GREET model is calculated based on the amount of electricity exported by a plant per volume of ethanol produced for an ethanol-only sugar cane mill. In the Ituiutaba and Itumbiara, which are integrated sugar-and-ethanol mills, a significant proportion of ethanol is produced from molasses that are by-product from sugar production. Hence, the bagasse energy used to generate electricity needs to be allocated among the different products. Allocation of co-generation export credit is based on the fraction of Total Reducing Sugars (TRS) measured after the sugar cane crush. The share of co-generation exports allocated to ethanol produced from juice is proportional to the TRS fraction used in ethanol production from juice. Similarly the share of co-generation exports credited to ethanol produced from molasses is proportionate to the TRS fraction used in ethanol production from molasses.

The credit for mechanised harvesting is based on the California Air Resources Board determination letters for accidentally burnt areas at Itumbiara and Ituiutaba mills harvested areas. Trash burning emissions are based on the GREET default.

TRANSPORT AND DISTRIBUTION:

The average distance for sugarcane transport to Ituiutaba and Itumbiara mills of 17 miles (27 km) is provided instead of GREET default of 12 miles.

The transportation mode and distance for ethanol is also different from GREET default. The ethanol is transported by heavy-duty truck from the mills to the rail terminal. The trucking distance is 137 km (85 miles) from Ituiutaba mill and 145 km (90 miles) from Itumbiara mill to the rail terminal. Ethanol is further transported by rail for 887 km (551 miles) to Port Santos.

All other emissions are as in the CA-GREET pathway for Brazilian sugarcane ethanol.

CARBON INTENSITY:

Table 1 summarizes GHG emissions from each stage of production of each of the integrated sugar and ethanol mills. All incremental emissions from farming through the production of ethanol are included in the carbon intensity of the produced ethanol. Land-use change emissions are also included, as well as emissions from adding the denaturant to the final product. The resulting carbon intensity is 56.98 gCO_2/MJ for the juice-to-ethanol pathway and 49.71 gCO_2/MJ for the molasses-to-ethanol pathways at the Ituiutaba mill, and 57.94 gCO_2/MJ for the juice-to-ethanol pathway, and 50.38 gCO_2/MJ for the molasses-to-ethanol pathways, respectively, at the Itumbiara mill.

Table 1

Summary of Well-to-Wheel Emissions for Ituiutaba mill.

DISAGGREGATED ITEM	VALUE REFERENCE	GHG EMISSIONS ALLOCATED TO CANE JUICE-TO-ETHANOL	GHG EMISSIONS ALLOCATED TO CANE MOLASSES-TO- ETHANOL :
Well-to-Tank (WTT) Allocated GHG Emissions:		***Mass Allocation Factor: 1.00***	***Mass Allocation Factor: 0.35***
Sugarcane Farming	See Worksheet* "Cane Farming Inputs"	3.59	3.59
Agricultural Chemicals Use	See Worksheet* "Cane Farming Inputs"	8.29	8.29
Straw Burning Emissions	See Worksheet* "Straw Burning"	7.19	7.19
- Less Credit for Mechanized Harvesting	BP Biofuels Claimed Mechanization Level: 97%	(6.97)	(6.97)
Sugarcane Transport	See Worksheet* "T&D"	1.39	1.39
Cane Juice Lime Pre-treatment	(Seabra et al, 2011)[1]	0.70	0.25
Sugar Production	See Worksheet* "Allocation"	-	1.89
Total Upstream GHG Emissions:		**14.18**	**15.62**
Ethanol Production	See Worksheet "EtOH Prod"	2.40	2.40
Ethanol Transport & Distribution	See Worksheet "T&D"	4.78	4.78
Addition of Denaturant	Indonesian Molasses Pathway	0.80	0.80
Well-to-Tank (WTT) GHG Emissions Estimate Before Electricity Export Credit:		***22.17***	***23.61***
Electricity Cogeneration and Surplus Export Credit	See Worksheet "Cogen Exp Cr"	(11.19)	(19.89)
Total Well-to-Tank (WTT) CI Estimate:		**10.98**	**3.71**
Tank-to-Wheels (TTW) GHG Emissions Estimate			
Ethanol Yield Estimate	See Worksheet "Allocation" (gallons / metric tonne cane)	26.75	9.36
Land Use Changes	Brazilian Sugarcane Ethanol	46.00	46.00
Final Well-to-Wheel (WTW) CI Estimate:		**56.98**	**49.71**

* All Worksheets referred to are worksheets within the Spreadsheet entitled "Final Disaggregation Analysis for BP-Biofuels ITT.xlsx"

[1] *Seabra et al. "Life cycle assessment of Brazilian sugarcane products: GHG emissions and energy use," Seabra, J.E.A., Macedo, I.C., Chum, H.L., Faroni, C.E., and Sarto,C.A., Biofuels, Bioproducts, & Biorefining, 5:519-532, March 7, 2011.*

Table 2

Summary of Well-to-Wheel Emissions for Itumbiara mill.

DISAGGREGATED ITEM	VALUE REFERENCE	GHG EMISSIONS ALLOCATED TO CANE JUICE-TO-ETHANOL	GHG EMISSIONS ALLOCATED TO CANE MOLASSES-TO- ETHANOL :
Well-to-Tank (WTT) Allocated GHG Emissions:		***Mass Allocation Factor: 1.00***	***Mass Allocation Factor: 0.35***
Sugarcane Farming	See Worksheet* "Cane Farming Inputs"	3.74	3.74
Agricultural Chemicals Use	See Worksheet* "Cane Farming Inputs"	8.64	8.64
Straw Burning Emissions	See Worksheet* "Straw Burning"	7.49	7.49
- Less Credit for Mechanized Harvesting	BP Biofuels Claimed Mechanization Level: 86%	(6.44)	(6.44)
Sugarcane Transport	See Worksheet* "T&D"	1.45	1.45
Cane Juice Pre-treatment	(Seabra et al, 2011)[2]	0.70	0.25
Sugar Production	See Worksheet* "Allocation"	-	1.97
Total Upstream GHG Emissions:		**15.59**	**17.11**
Ethanol Production	See Worksheet "EtOH Prod"	2.40	2.40
Ethanol Transport & Distribution	See Worksheet "T&D"	4.82	4.82
Addition of Denaturant	Indonesian Molasses Pathway	0.80	0.80
Well-to-Tank (WTT) GHG Emissions Estimate Before Electricity Export Credit:		***23.61***	***25.13***
Electricity Cogeneration and Surplus Export Credit	See Worksheet "Cogen Exp Cr"	(11.67)	(20.75)
Total Well-to-Tank (WTT) CI Estimate:		**11.94**	**4.38**
Tank-to-Wheels (TTW) GHG Emissions Estimate			
Ethanol Yield Estimate	See Worksheet "Allocation" (gallons / metric tonne cane)	25.65	8.98
Land Use Changes	Brazilian Sugarcane Ethanol	46.00	46.00
Final Well-to-Wheel (WTW) CI Estimate:		**57.94**	**50.38**

* All Worksheets referred to are worksheets within the Spreadsheet entitled "Final Disaggregation Analysis for BP-Biofuels ITB.xlsx"

[2] *Seabra et al. "Life cycle assessment of Brazilian sugarcane products: GHG emissions and energy use," Seabra, J.E.A., Macedo, I.C., Chum, H.L., Faroni, C.E., and Sarto,C.A., Biofuels, Bioproducts, & Biorefining, 5:519-532, March 7, 2011.*

Itumbiara and Ituiutaba mills provided actual data for power production and exports for the two most recent years for calculation of co-generation credit. The co-generation credit is higher than in the reference pathway due to the fact that Itumbiara and Ituiutaba export significantly more electricity to the grid than in the reference pathway. The mills have modern high-pressure boilers allowing better utilization of bagasse for power generation and use low pressure steam for internal process consumption. The processes have been improved since acquisition and the plants are managed by a highly professional staff. Both plants have implemented an operational management system that includes continuous improvements requirements in operating parameters and energy efficiency. Greater energy efficiency is linked to additional business revenues from electricity sales. Hence, business goals and improvements in the energy efficiency of assets operations are well aligned.